A NEW CONTROLLED ALBEDO MAP OF MERCURY. M.S. Robinson[1], M.E. Davies[2], T.R. Colvin[2], K.E. Edwards[1], [1]U.S. Geological Survey, 2255 N. Gemini Dr., Flagstaff, AZ, 86001, [2]RAND, Santa Monica, CA.

A new albedo map of Mercury has been completed utilizing images (Clear filter) acquired during the first Mariner 10 encounter in 1974. For the portion of Mercury observed by Mariner 10 the range of albedo is found to be less than that of the lunar farside, one standard deviation is 14% of the mean vs. 17% of the mean, respectively. The brightest material found has an albedo ~2.5x that of the mean (.36 vs. .14) and does not appear to be associated with immature crater ejecta deposits.

Geometric Calibration: We have completed a new analytical triangulation that contains 10,704 measurements of 2306 points from 811 images acquired during all three encounters with Mercury [**1**]. Improvements were made over the previous control net [**2**] through better reseau location information and deletion of points found to contain erroneous measurements. The overdetermination in our new control net is 3.04, and the standard measurement error is 0.00844 mm (0.6 pixels). Mercury's radius was assumed to be 2439 km except where occultation data and radar measurements give a more precise value. We have also derived new values for the focal lengths of each camera (Camera A 1493.6 mm, Camera B 1500.1 mm) and an improved value for the planet rotation (ω_0 = 329.548). Camera angles and spacecraft vectors for all 811 images are available in ascii format. Images not included in the control net are being updated and these updates will be made available in the near future.

Radiometric Calibration: We utilize a new calibration scheme to process these images such precise quantitative measures of albedo may be determined [**3,4**]. Prelaunch flat field images acquired at varying exposure times provide a nonlinearity and sensitivity nonuniformity correction while an average of inflight images of deep space correct system offset. We utilized low contrast Mariner 10 images of the venusian atmosphere to identify vidicon blemishes and create a stencil from which affected areas were simply deleted from all the mercurian images. Redundancies in the image coverage was utilized to fill gaps caused by the stenciling and to increase the signal to noise ratio (SNR) of the mosaic. Instead of overlaying each image during the mosaicking we averaged them; for the data presented here each pixel was thus formed from one to 5 frames. The original spatial scale of the images used in the mosaic ranged from ~0.5 km/pixel to ~1.5 km/pixel at the subspacecraft point; the data were reprojected to an orthographic projection at 4.0 km/pixel to further enhance the SNR of the final mosaic. The new averaging technique, conservative resampling, and blemish deletion reduce the effects of system noise, bit errors, and calibration residuals such that subtle albedo units can be identified with a high degree of confidence.

Uncertainties in the actual exposure times were accounted for by processing each set of images with like exposure times separately. Regions of overlap between these like-exposure mosaics were used to normalize all data to the same exposure time (32.6 msec, incoming frame 27090, outgoing frames 188-198, 220-230 even numbers). Absolute calibration was derived by first photometrically normalizing the images to 0° phase, applying Hapke modeling [5]. Utilizing parameters derived for the Moon [6,7] and those derived for Mercury both resulted in overcorrection at the mercurian poles. Previous work with Galileo SSI image data has shown that the parameter Θ (theta bar) can be adjusted to compensate for this effect [8]. Iterative adjustment and visual inspection of the "flatness" of the mercurian mosaic led us to use the following values for the Hapke parameters: w = 0.21, h = 0.07, B_0 = 2.0, b = 0.29, c = 0.39, Θ (theta bar) = 15. Secondly, a coefficient was derived such that the disc integrated average of the final mosaic matches the Earth-based telescopic, disc-integrated 554 nm geometric albedo of 0.14 [7].

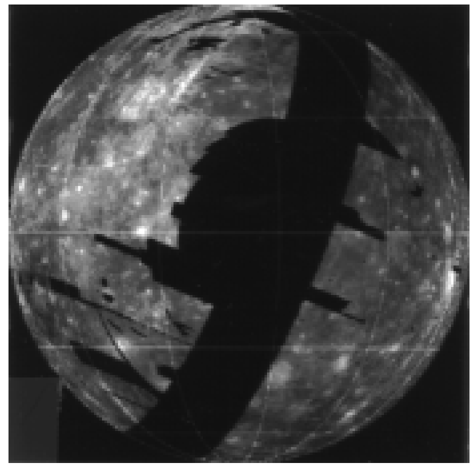

Figure 1. Albedo map of the regions of Mercury imaged during the first encounter with resolutions ranging from 500 - 1500 m/pixel (orthographic view centered at 0° latitude, 100° longitude). We find that the highest albedo materials in the mosaic (i.e. floor deposits of crater Tyagaraja lat. 3° long. 149°) are about 2.5x the global average (0.36 vs. 0.14 respectively), see also [4].

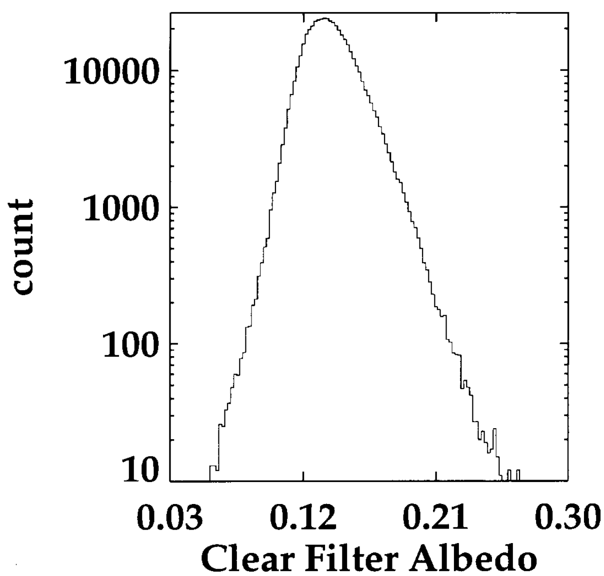

Figure 2. Histogram showing range of albedos (clear filter) seen on Mercury, one standard deviation equals 0.019, or 14% of the mean (mean is defined as 0.14). For comparison the standard deviation for 750 nm albedo of the lunar farside (90 to 270) longitude is 17% of the mean. All pixels in the mosaic with an emission angle greater than 80° or an incidence angle of greater than 75° were excluded from the analysis.

References:

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